ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING OF MECHANICAL SYSTEMS

Course Code	20ME4702A	**Year**	IV	**Semester**	I
Course Category	Professional Elective- IV	**Branch**	ME	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	NIL
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Mark**	100

Course Outcomes: Upon successful completion of the course, the student will be able to

	Statement	Skill	Level	Unit
CO1	Understand the core concepts of Mechanical Systems in the context of Industry 4.0	Understand	L2	1,2,3
CO2	Understand the fundamental concepts of fuzzy sets and its applications.	Understand	L2	4,5
CO3	Apply AI, ML and Deep Learning concepts on Various Mechanical Systems	Apply	L3	2,3
CO4	Provide adequate knowledge of fuzzy logic, in solving social and engineering problems	Apply	L3	4,5

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H: High, M: Medium, L: Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2							1		2	3	2
CO2	3	3	2							1		2	3	2
CO3	3	3	2							1		2	3	2
CO4	3	3	2							1		2	3	2

Syllabus

UNIT	Course Content	Mapped CO s
I	**Introduction to Mechanical Systems:** Evolution in the context of Industry 4.0, Key issues: Adaptability, Intelligence, Autonomy, Safety, Sustainability, Interoperability, Flexibility of Mechanical Systems. **Introduction of Statistics**: Descriptive statistics: Central tendency measures, Dispersion measures, data distributions, centre limit theorem, sampling, sampling methods; Inferential Statistics: Hypothesis testing, confidence level, degree of freedom, P-value, Chi-square test, ANOVA, Correlation V's Regression, Uses of Correlation and regression.	**CO1**
II	**Artificial Intelligence:** Brief review of AI history, Problem formulation: Graph structure, Graph implementation, state space representation, search graph and search tree, Search Algorithms: random search, Depth-first, breadth-first search and uniform-cost search. Heuristic: Best first search, A* and AO* algorithm, generalization of search problems. Ontology; Fuzzy; Metaheuristics.	**CO1, CO3**
III	**Machine Learning:** Overview of supervised and unsupervised learning; Supervised Learning: Linear Regression, Non-linear Regression Model evaluation methods,	**CO1, CO3**

	Logistic Regression, Neural Networks; Unsupervised Learning: K-means clustering, C-means Clustering. Convolutional Neural Networks (CNN), Pooling, Padding Operations, Interpretability in CNNs, Limitations in CNN. Cases with respect to different mechanical systems.	
IV	**Introduction, Classical Sets and Fuzzy Sets** Background, Uncertainty and Imprecision, Statistics and Random Processes, Uncertainty in Information, Fuzzy Sets and Membership, Chance versus Ambiguity. Classical Sets - Operations on Classical Sets, Properties of Classical (Crisp) Sets, Mapping of Classical Sets to Functions Fuzzy Sets - Fuzzy Set operations, Properties of Fuzzy Sets. Sets as Points in Hypercubes	**CO2, CO4**
V	**Classical Logic and Fuzzy Logic** Classical Predicate Logic – Tautologies, Contradictions, Equivalence, Exclusive OR and Exclusive NOR, Logical Proofs, Deductive Inferences. Fuzzy Logic, Approximate Reasoning, Fuzzy Tautologies, Contradictions, Equivalence and Logical Proofs, Other forms of the Implication Operation, Other forms of the Composition Operation	**CO2, CO4**

Learning Resources

Text Book(s):

1. Rajkumar, Dionisio De Niz ,and Mark Klein, Cyber-Physical Systems, Wesley Professional.
2. Robert Levine et al., "A Comprehensive guide to AI and Expert Systems", McGraw Hill Inc, 1986.
3. Ross, T. J. (2005), "Fuzzy logic with engineering applications," John Wiley & Sons.

References:

1. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press, 2015.
2. E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems: A Cyber-Physical Systems Approach", 2011.
3. C. Cassandras, S. Lafortune, "Introduction to Discrete Event Systems", Springer 2007.
4. Constance Heitmeyer and Dino Mandrioli, "Formal methods for real-time computing", Wiley publisher, 1996.
5. Montgomery Douglas, 2017. Design of Experiments, John Wiley and Sons, Inc.
6. J.-S. R. Jang, C.-T. Sun, and E. Mizutani, "Neuro-Fuzzy and Soft Computing" Prentice Hall.